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Research Article

Tilia saxatilis (Malvaceae), a new species from limestone areas of Guangxi, China

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Abstract

Tilia saxatilis Z.C.Lu & W.B.Xu, a new species was discovered in limestone areas of Guangxi, China. The morphology shows that *T. saxatilis* is similar to *T. tuan* Szyszyl., but differs by having leaf blades that are oblong or ovate-oblong, entire margins, fruit ellipsoid, 5-angled, apex acute.

Key words: Malvaceae, morphology, new species, taxonomy, *Tilia tuan*

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Introduction

The genus *Tilia* L. with 23–40 species in the family Malvaceae is distributed in Europe, North America and East Asia where in occurs primarily in temperate and subtropical regions (Zhuge and Tang 1995; Tang and Zhuge 1996; Pigott 2002; Tang et al. 2007; Pigott 2012). *Tilia* is easily recognised by its unique tongue-like bracts adnate to the peduncle of the inflorescence and leaf blades base oblique (Chang 1989; Tang et al. 2007).

The genus *Tilia* was firstly described by Linnaeus (1753) in the "Species Plantarum" and the earlier taxonomic treatments mainly focused on European and American species. Chang (1989) presented a comprehensive treatment of Chinese *Tilia* in the "Flora Republicae Popularis Sinicae", which included a key and descriptions of 32 species. Pigott (2012) provided a very comprehensive taxonomic treatment of *Tilia* in his monograph, accepted 23 species, of which two species were in North American, four species ranging from Europe to West Asia and 17 species in East Asia and also confirmed China is the centre of species diversity for the genus *Tilia*, with 15 species (11 endemic).

During the investigation of plant diversity in the assessment area of Southwest Karst National Park (which is currently being prepared) in July, September and October 2023, we collected a species of *Tilia* with flowers and mature fruits from limestone forests in Dahua County and Du'an County, Hechi City, Guangxi, China. After carefully checking the morphological characters of the specimens, comprehensively consulting relevant literature (Chang 1989; Zhuge and Tang

1995; Tang and Zhuge 1996; Pigott 2002; Tang et al. 2007; Pigott 2012), consulting herbarium specimens and examining the other related species of *Tilia*, we confirmed it is a new species. It is described below.

Materials and methods

Specimens of this new species were collected from Dahua County and Du'an County, Hechi City, Guangxi, China. After that, we carefully studied relevant literature and the morphological characters of the specimens, which involved measuring and recording the size, shape and colour of bark, branchlets, winter buds, leaves, cymes, bracts, pedicel, sepals, petals, stamens, ovary, fruit, seeds and so on. We examined herbarium specimens at BJFC, IBK, IBSC, IFP, HIB, KUN, PE and WUK (Herbarium codes follow Thiers 2024). The other related species of *Tilia* were examined in online images from the Chinese Virtual Herbarium (https://www.cvh.ac.cn/), JSTOR Global Plants (https://plants.jstor.org/) and Kew Herbarium Catalogue (http://apps.kew.org/herbcat/gotoHomePage.do). The morphological description for the new species is based on the cited type specimens (holotype, isotypes and paratypes) below and general terminology follows the "Flora of China" (Tang et al. 2007).

Taxonomic treatment

***Tilia saxatilis* Z.C.Lu & W.B.Xu, sp. nov.**
urn:lsid:ipni.org:names:77355914-1
Figs 1–3
Chinese name: shí shān duàn (石山椴)

Diagnosis. This new species is similar to *Tilia tuan* Szyszyl., but differs in having leaf blades that are oblong or ovate-oblong (vs. narrowly ovate or ovate-oblong to ovate-orbicular), margins entire (vs. entire or with a few minute teeth near apex or prominently dentate); fruit ellipsoid (vs. globose or obovoid-globose), 5-angled (vs. not ridged), apex acute (vs. rounded).

Type. China • Guangxi: Hechi City, Du'an County, Bao'an Town, Shangzhen Village, Nongwen, around the point 24.07999417°N, 107.82876°E, limestone slope, alt. 769 m, 28 September 2023, *W. B. Xu, Z. C. Lu, M. L Mo, S. L. Chang & J. Q. Huang 17323* (holotype: IBK00464802; isotypes: IBK00464803, IBK00464804, IBSC, PE).

Description. Trees 5–15 m tall, DBH 10–80 cm. Bark dark grey; branchlets glabrous; winter buds ovoid, glabrous or slightly hairy at tip. Petiole 0.8–2 cm long, glabrous; leaf blades oblong or ovate-oblong, (3.5–)4.5–10(–14.4) cm long, 2–5.5(–6.2) cm wide, thickly papery, glabrous on both sides, with brown tuft domatia in vein axils of abaxial surface, lateral veins 7–8 pairs, raised on abaxial surface, reticulate veins distinct abaxially, base oblique, truncate or cordate, margins entire, apex acuminate. Cymes 5–16-flowered, 3.5–6 cm long, peduncles glabrous. Bracts narrowly oblong, 3.8–9 cm long, 1–2 cm wide, adnate to peduncle for 1/3–2/5 of its length, glabrous or adaxially slightly hairy along mid-vein, apex obtuse, sessile. Pedicels 2–4 mm long, glabrous. Sepals 5, ovate, 4.5–5 mm long, abaxially tomentose, adaxially tomentose or with long tomentose at base. Petals oblong, 5–6 mm long, glabrous. Stamens ca. 2 mm long,

Figure 1. *Tilia saxatilis* sp. nov. **A** habit **B** winter buds **C** flowering branches **D** trunk **E** fruiting branches **F** habitat (White circle shows where the new species grow).

glabrous; staminodes 5, slightly smaller than petals, glabrous. Ovary densely tomentose; style 1–2 mm long, glabrous. Fruit ellipsoid, 5-angled, 8–12 mm long, 5–6 mm wide, densely appressed tomentose, apex acute; exocarp woody, hard, indehiscent. Seed ellipsoid, ca. 5 mm long.

Etymology. The specific epithet '*saxatilis*' refers to the limestone habitats of this new species.

Phenology. Flowering July and fruiting from September to October.

Distribution and habitat. *Tilia saxatilis* has only been collected from five localities restricted to central Guangxi of China. It grows sporadically in forests on limestone slopes, rare on peaks, at an elevation of 700–950 m. The type localities are typical limestone karst landform and belong to the southern subtropical monsoon climate areas, the average annual temperature being 18–21 °C; the annual sunshine duration is 1220–1590 hours and the annual accumulated temperature is about 6300 °C; the annual average relative humidity is 74–80%; the average annual rainfall is 1250–1680 mm and the evaporation is 1210–1650 mm.

Conservation status. The new species has been found in two localities in Du'an County and three localities in Dahua County, Guangxi, China. These five localities are in the assessment area of Southwest Karst National Park, which is currently being prepared. The extent of occurrence is about 960 km^2 (< 5000 km^2) and its occupancy area is predicted to continuously decline in the future due to grazing and firewood collection by local people. Therefore, according to the IUCN Red List Categories and Criteria (IUCN Standards and Petitions Committee 2022), *Tilia saxatilis* should be considered in the Endangered (EN) [B1ab(iii)] category at present.

Additional specimens examined (paratypes). CHINA • Guangxi: Dahua County, Qibainong Town, Nonghe Village, Nongge, around the point 24.121001°N, 107.727671°E, limestone slope; alt. 880 m; 19 July 2023; *W. B. Xu, Z. C. Lu, M. L Mo, S. L. Chang & J. Q. Huang 16285* (IBK, KUN, PE) • ibid.; 19 July 2023; *W. B. Xu, Z. C. Lu, M. L Mo, S. L. Chang & J. Q. Huang 16312* (IBK, CSH, IBSC) • Du'an County, Bao'an Town, Shangzhen Village, Nongwen, around the point 24.07999417°N, 107.82876°E, limestone slope; alt. 769 m; 28 September 2023; *W. B. Xu, Z. C. Lu, M. L Mo, S. L. Chang & J. Q. Huang 17300* (IBK) • ibid.; 28 September 2023; *W. B. Xu, Z. C. Lu, M. L Mo, S. L. Chang & J. Q. Huang 17301* (IBK, GXMG, GXMI) • ibid.; 28 September 2023; *W. B. Xu, Z. C. Lu, M. L Mo, S. L. Chang & J. Q. Huang 17302* (IBK, GXMI) • ibid.; 28 September 2023; *W. B. Xu, Z. C. Lu, M. L Mo, S. L. Chang & J. Q. Huang 17303* (IBK, GXMG, CSH) • ibid.; 28 September 2023; *W. B. Xu, Z. C. Lu, M. L Mo, S. L. Chang & J. Q. Huang 17322* (IBK, PE, KUN) • Du'an County, Bao'an Town, Yuanli Village, Nongkou, around the point 24.10944°N, 107.811669°E, limestone slope; alt. 860 m; 30 September 2023; *W. B. Xu, Z. C. Lu, M. L Mo, S. L. Chang & J. Q. Huang 17367* (IBK) • ibid.; 30 September 2023; *W. B. Xu, Z. C. Lu, M. L Mo, S. L. Chang & J. Q. Huang 17368* (IBK) • Dahua County, Bansheng Town, Nongcong Village, Nongji, around the point 24°13'21.75"N, 107°45'25.99"E, limestone slope; alt. 936 m; 1 October 2023; *W. B. Xu, Z. C. Lu, M. L Mo, S. L. Chang & J. Q. Huang 17403* (IBK) • Dahua County, Qibainong Town, Nongjing Village, Baxiang, around the point 24.088763°N, 107.773282°E, limestone peak; alt. 920 m; 4 October 2023; *W. B. Xu, Z. C. Lu, M. L Mo, S. L. Chang & J. Q. Huang 17503* (IBK).

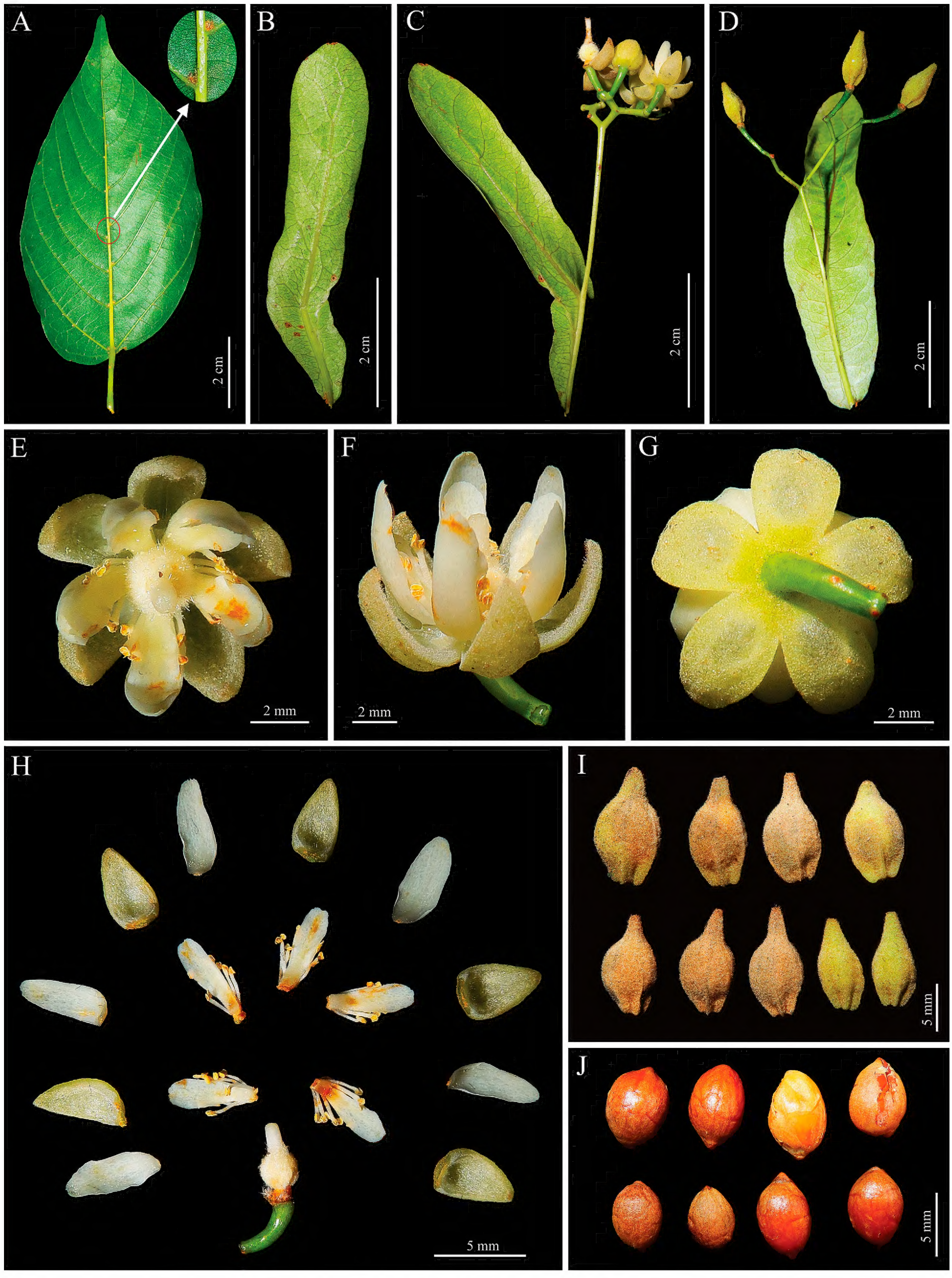

Figure 2. *Tilia saxatilis* sp. nov. **A** leaf in abaxial view (Red circle shows tuft domatia in vein axils) **B** bract in abaxial view **C** bract and cyme **D** bract and infructescence **E** flower in frontal view **F** flower in lateral view **G** flower in dorsal view **H** dissection of flower **I** fruits **J** seeds.

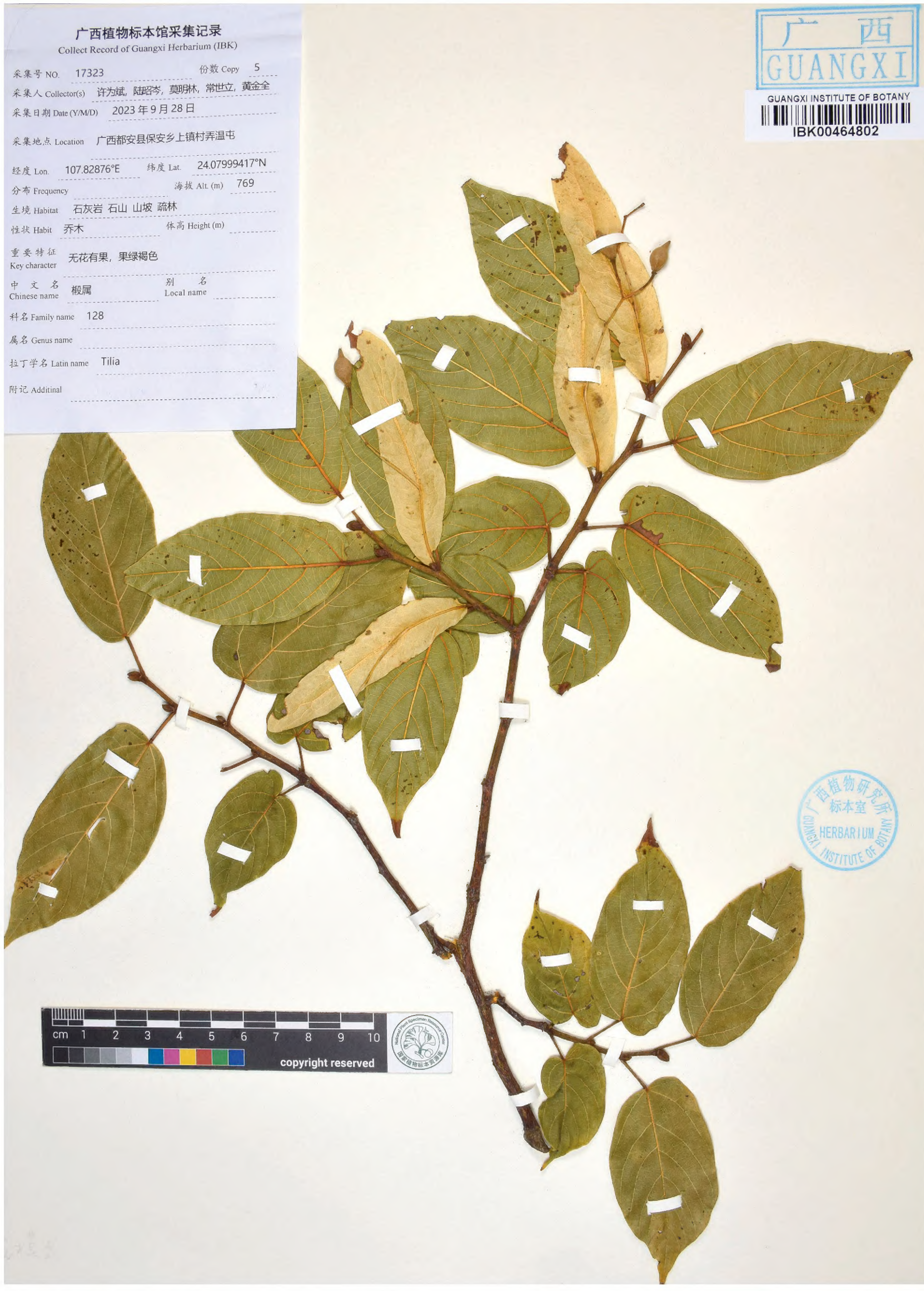
广西植物标本馆采集记录
Collect Record of Guangxi Herbarium (IBK)
采集号 NO. 17323
份数 Copy 5
采集人 Collector(s) 许为斌, 陆昭岑, 莫明林, 常世立, 黄金全
采集日期 Date (Y/M/D) 2023 年 9 月 28 日
采集地点 Location 广西都安县保安乡上镇村弄温屯
经度 Lon. 107.82876°E
纬度 Lat. 24.07999417°N
分布 Frequency
海拔 Alt. (m) 769
生境 Habitat 石灰岩 石山 山坡 疏林
性状 Habit 乔木
体高 Height (m)
重要特征 Key character 无花有果，果绿褐色
中文名 Chinese name 椴属
别名 Local name
科名 Family name 128
属名 Genus name
拉丁学名 Latin name Tilia
附记 Additinal
广西 GUANGXI
GUANGXI INSTITUTE OF BOTANY
IBK00464802
广西植物研究所 标本室 GUANGXI INSTITUTE OF BOTANY HERBARIUM
cm 1 2 3 4 5 6 7 8 9 10
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Figure 3. The holotype sheet of *Tilia saxatilis* (IBK).

Notes. *Tilia saxatilis* has glabrous branchlets, leaf blades base oblique, truncate or cordate, abaxially hairy only in vein axils, bracts narrowly oblong, adnate to inflorescence peduncle, sessile, staminodes 5 and fruits indehiscent. Based on these morphological characters, *T. saxatilis* is similar to *T. tuan* (Tang et al. 2007), but differs from the latter in having leaf blades that are oblong or ovate-oblong, margin entire, fruit ellipsoid, 5-angled, apex acute. The morphological differences between *T. saxatilis* and *T. tuan* are shown in Table 1.

In addition, several schemes for subdividing the genus *Tilia* have been described (Chang 1989; Zhuge and Tang 1995; Pigott 2012) and, according to the different morphological characteristics, *T. saxatilis* would be placed in different position. Chang (1989) gave two sections for *Tilia* in the "Flora Republicae Popularis Sinicae"; *T. saxatilis* would be placed in the sect. *Tilia* L. based on the fruit indehiscent when dry. Zhuge and Tang (1995) divided *Tilia* into three sections; *T. saxatilis* would be placed in the sect. *Lindnera* Reichb. based on the woody fruit exocarp. In Pigott's (2012) monograph, the genus *Tilia* was divided into four sections; *T. saxatilis* would be placed in the section *Astrophilyra* V. Engler based on the leaf blades upper surface green, glabrous, lower surface pale green, hairy only in vein axils, fruits not splitting, flowers with staminodes.

Table 1. Morphological characters distinguishing *T. saxatilis* from *T. tuan*.

Characters	*T. saxatilis*	*T. tuan*
Branchlets	Glabrous	Glabrous or tomentose
Leaf blades	Oblong or ovate-oblong, margin entire	Narrowly ovate or ovate-oblong to ovate-orbicular, margin entire or with a few minute teeth near apex or prominently dentate
Cymes	5–16-flowered, 3.5–6 cm long	3–22-flowered, 5–14 cm long
Bracts	3.8–9 cm long, 1–2 cm wide, sessile	6–16 cm long, 1–3 cm wide, sessile or with stalks 5–8 mm long
Pedicel	2–4 mm long	4–9 mm long
Fruit	Ellipsoid, 5-angled, apex acute	Globose or obovoid-globose, not ridged, apex rounded

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

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Author contributions

Wei-Bin Xu and Zhao-Cen Lu conceived the study. All authors participated in specimen collection. Zhao-Cen Lu, Shi-Li Chang, Ming-Lin Mo and You-Dong Wu conducted the measurements of morphological characters. Zhao-Cen Lu wrote the manuscript. All authors approved the final version of the manuscript.

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Data availability

All of the data that support the findings of this study are available in the main text.

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